

PSYCHOLOGY

(8th Edition)

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PowerPoint Slides

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Memory

Chapter 9

Memory

The Phenomenon of Memory

- Information Processing

Encoding: Getting Information in

- How We Encode
- What We Encode

Memory

Storage: Retaining Information

- Sensory Memory
- Working/Short-term Memory
- Long-Term Memory
- Storing Memories in the Brain

Memory

Retrieval: Getting Information Out

- Retrieval Cues

Forgetting

- Encoding Failure
- Storage Decay
- Retrieval Failure

Memory

Memory Construction

- Misinformation and Imagination Effect
- Source Amnesia
- Discerning True and False Memories
- Children's Eyewitness Recall
- Repressed or Constructed Memories of Abuse?

Memory

Improving Memory

Memory

Memory is the basis for knowing your friends, your neighbors, the English language, the national anthem, and yourself.

If memory was nonexistent, everyone would be a stranger to you; every language foreign; every task new; and even you yourself would be a stranger.

The Phenomenon of Memory

Memory is any indication that learning has persisted over time. It is our ability to store and retrieve information.

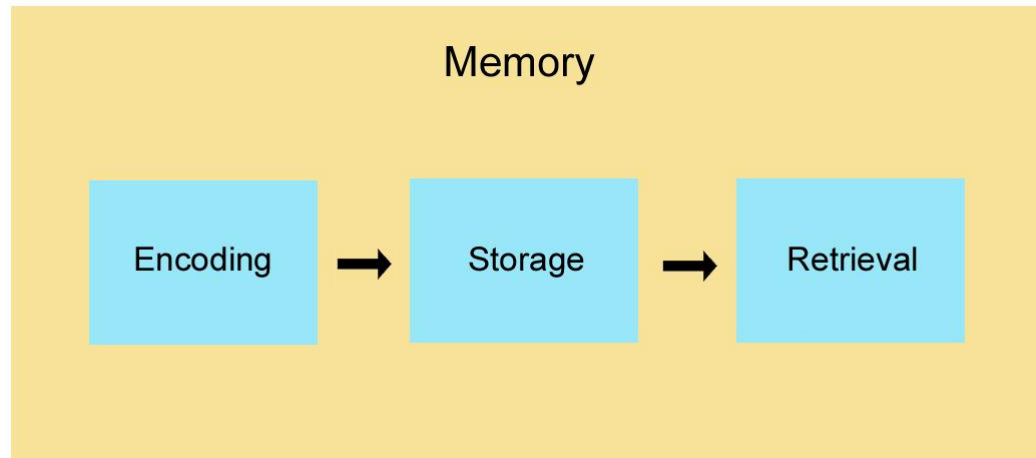
Flashbulb Memory

A unique and highly emotional moment may give rise to a clear, strong, and persistent memory called **flashbulb memory**. However, this memory is not free from errors.

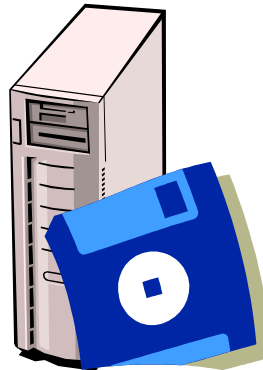


President Bush being told of 9/11 attack.

Stages of Memory



Keyboard
(Encoding)



Disk
(Storage)



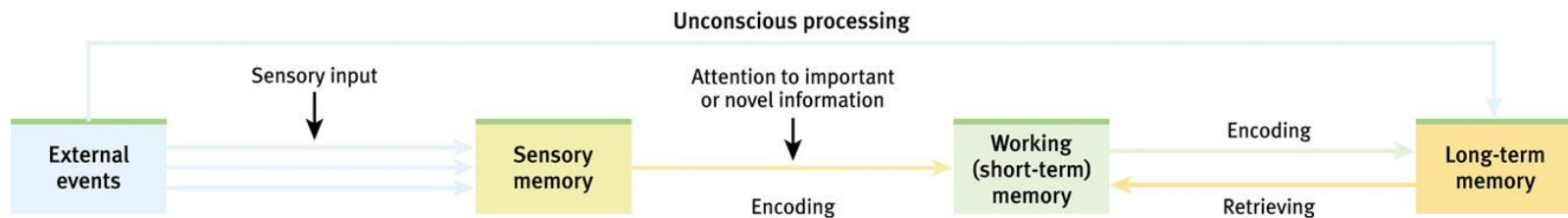
Monitor
(Retrieval)

Sequential Process



Information Processing

The Atkinson-Schiffrin (1968) three-stage model of memory includes a) **sensory memory**, b) **short-term memory**, and c) **long-term memory**.



Bob Daemmrich/ The Image Works

Sensory memory registers incoming information, allowing your brain to capture for a fleeting moment a sea of faces.



Bob Daemmrich/ The Image Works

We pay attention to and encode important or novel stimuli—in this case an angry face in the crowd.



Frank Wartenberg/ Picture Press/ Corbis

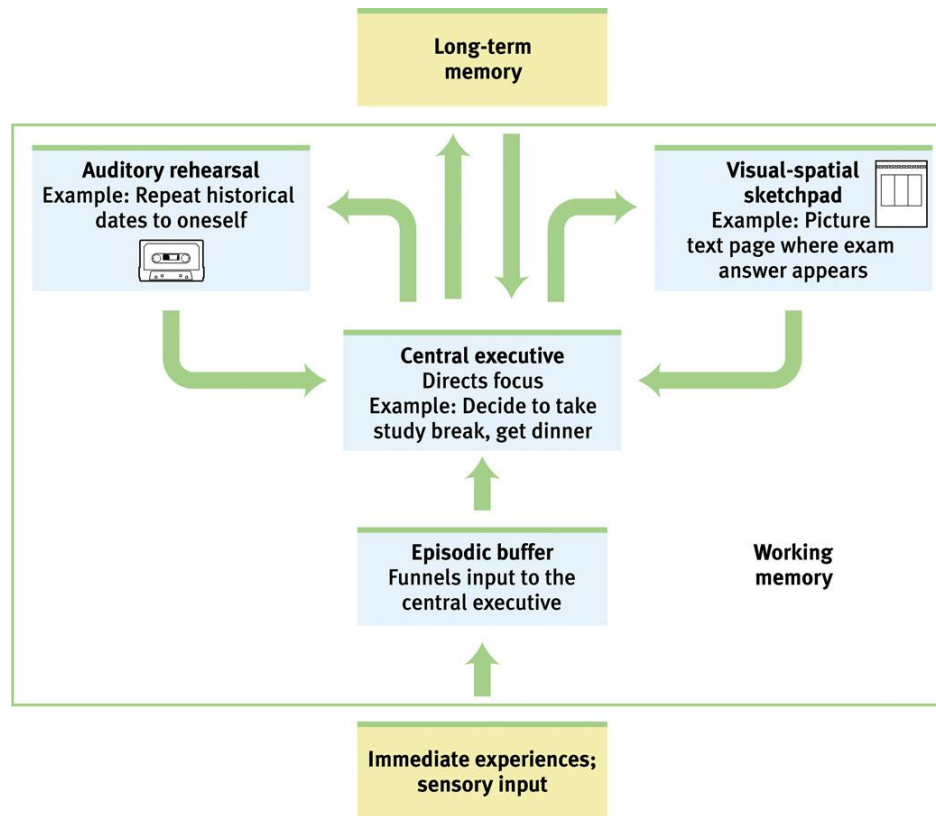
If we stare at the face long enough (rehearsal), or if we're sufficiently disturbed by it (it's deemed "important"), we will encode it for long-term storage, and we may, an hour later, be able to call up an image of the face.

Problems with the Model

1. Some information skips the first two stages and enters long-term memory automatically.
2. Since we cannot focus all the sensory information in the environment, we select information (through attention) that is important to us.
3. The nature of short-term memory is more complex.

Working Memory

Alan Baddeley (2002) proposes that working memory contains auditory and visual processing controlled by the central executive through an episodic buffer.



Encoding: Getting Information In

How We Encode

1. Some information (route to your school) is automatically processed.
2. However, new or unusual information (friend's new cell-phone number) requires attention and effort.

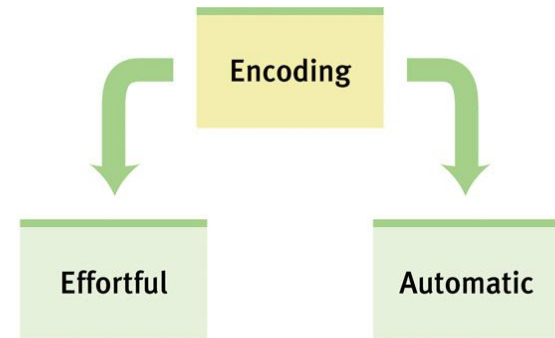
Automatic Processing

We process an enormous amount of information effortlessly, such as the following:

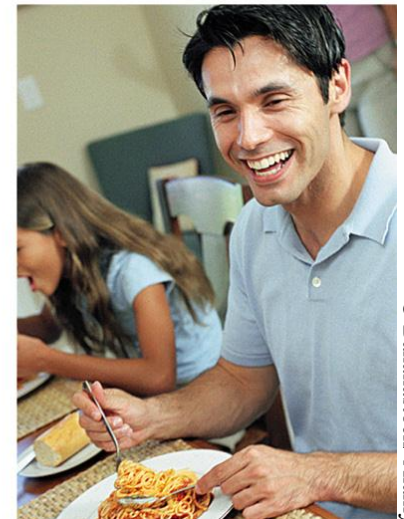
1. **Space:** While reading a textbook, you automatically encode the place of a picture on a page.
2. **Time:** We unintentionally note the events that take place in a day.
3. **Frequency:** You effortlessly keep track of things that happen to you.

Effortful Processing

Committing novel information to memory requires effort just like learning a concept from a textbook. Such processing leads to durable and accessible memories.



Spencer Grant/ Photo Edit



© Bananastock/ Alamy

Rehearsal

Effortful learning
usually requires
rehearsal or conscious
repetition.

Ebbinghaus studied
rehearsal by using
nonsense syllables:
TUV YOF GEK XOZ



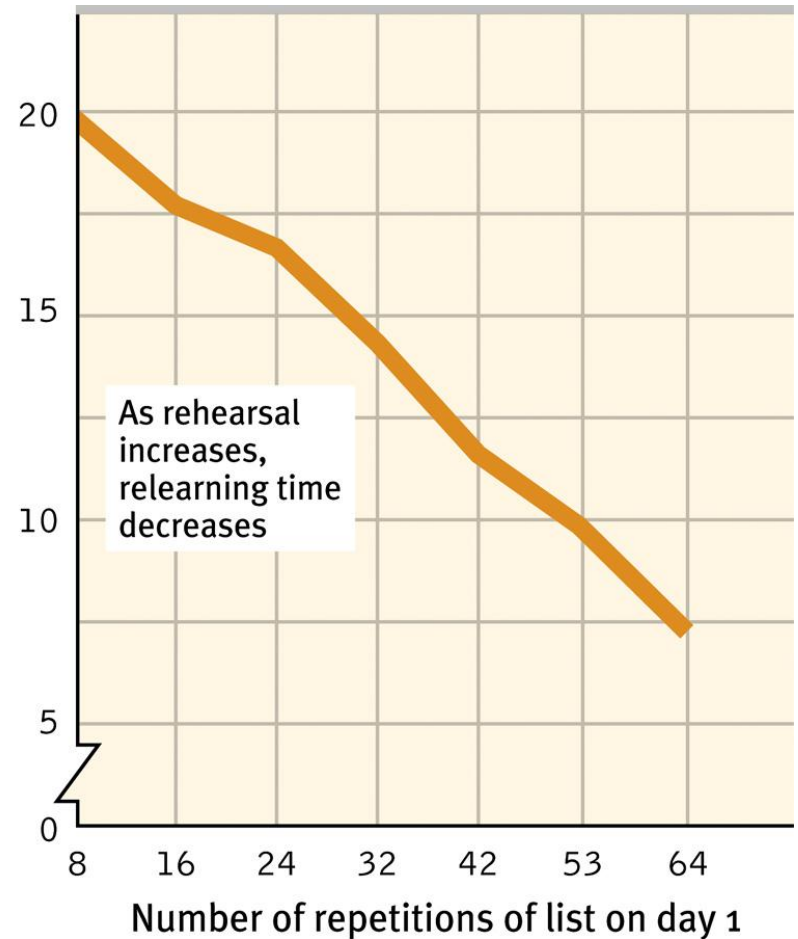
<http://www.isbn3-540-21358-9.de>

Hermann Ebbinghaus
(1850-1909)

Rehearsal

The more times the nonsense syllables were practiced on Day 1, the fewer repetitions were required to remember them on Day 2.

Time in minutes
taken to relearn
list on day 2



Memory Effects

1. **Next-in-line-Effect:** When you are so anxious about being next that you cannot remember what the person just before you in line says, but you can recall what other people around you say.
2. **Spacing Effect:** We retain information better when we rehearse over time.
3. **Serial Position Effect:** When your recall is better for first and last items on a list, but poor for middle items.

Spacing Effect

Distributing rehearsal (**spacing effect**) is better than practicing all at once. Robert Frost's poem could be memorized with fair ease if spread over time.

ACQUAINTED WITH THE NIGHT

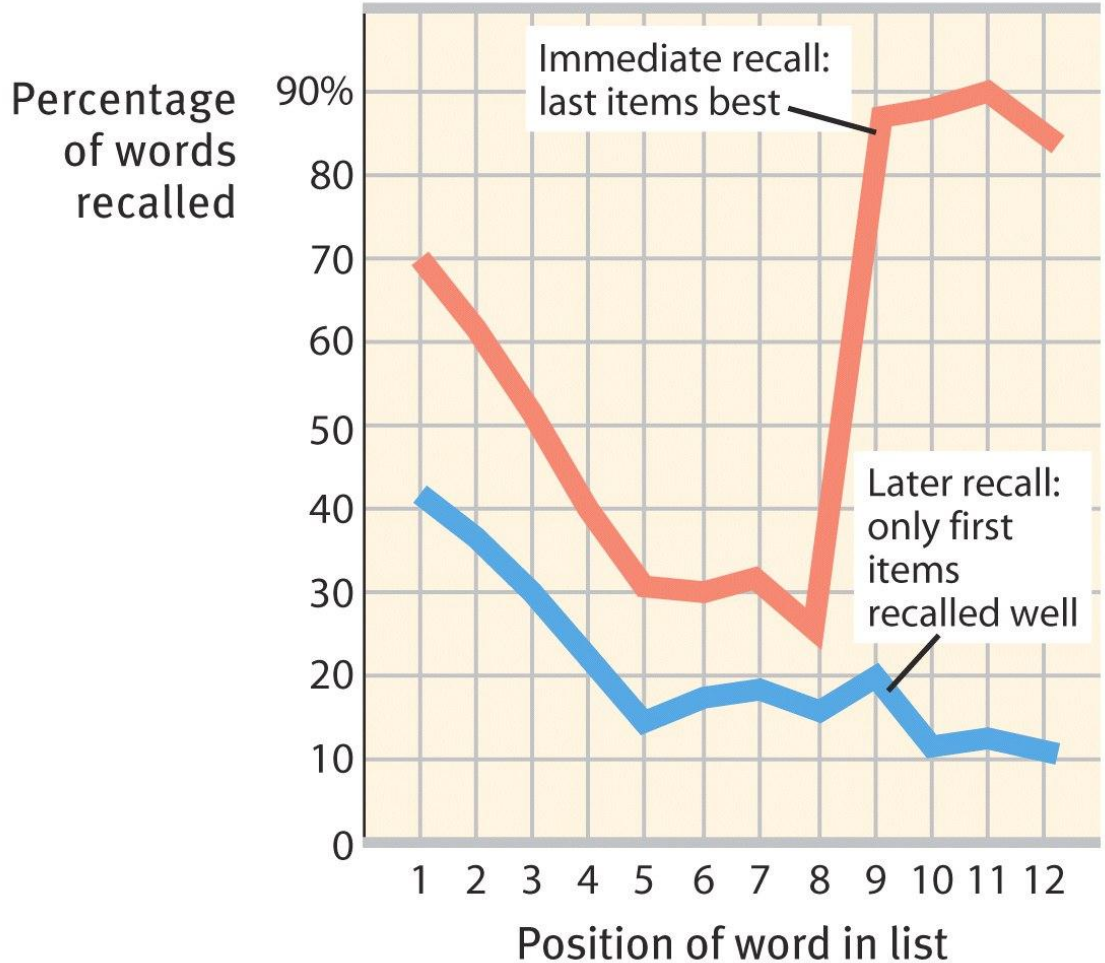
Robert Frost

I have been one acquainted with the night.
I have walked out in rain — and back in rain.
I have outwalked the furthest city light.

... ..

Serial Position Effect

1.	TUV	Better recall
2.	ZOF	
3.	GEK	
4.	WAV	
5.	XOZ	Poor recall
6.	TIK	
7.	FUT	
8.	WIB	
9.	SAR	Better recall
10.	POZ	
11.	REY	
12.	GIJ	



What We Encode

1. Encoding by meaning
2. Encoding by images
3. Encoding by organization

Encoding Meaning

“Whale”

Q: Did the word begin
with a capital letter?

Structural
Encoding

Shallow

Q: Did the word rhyme
with the word
“weight”?

Phonemic
Encoding

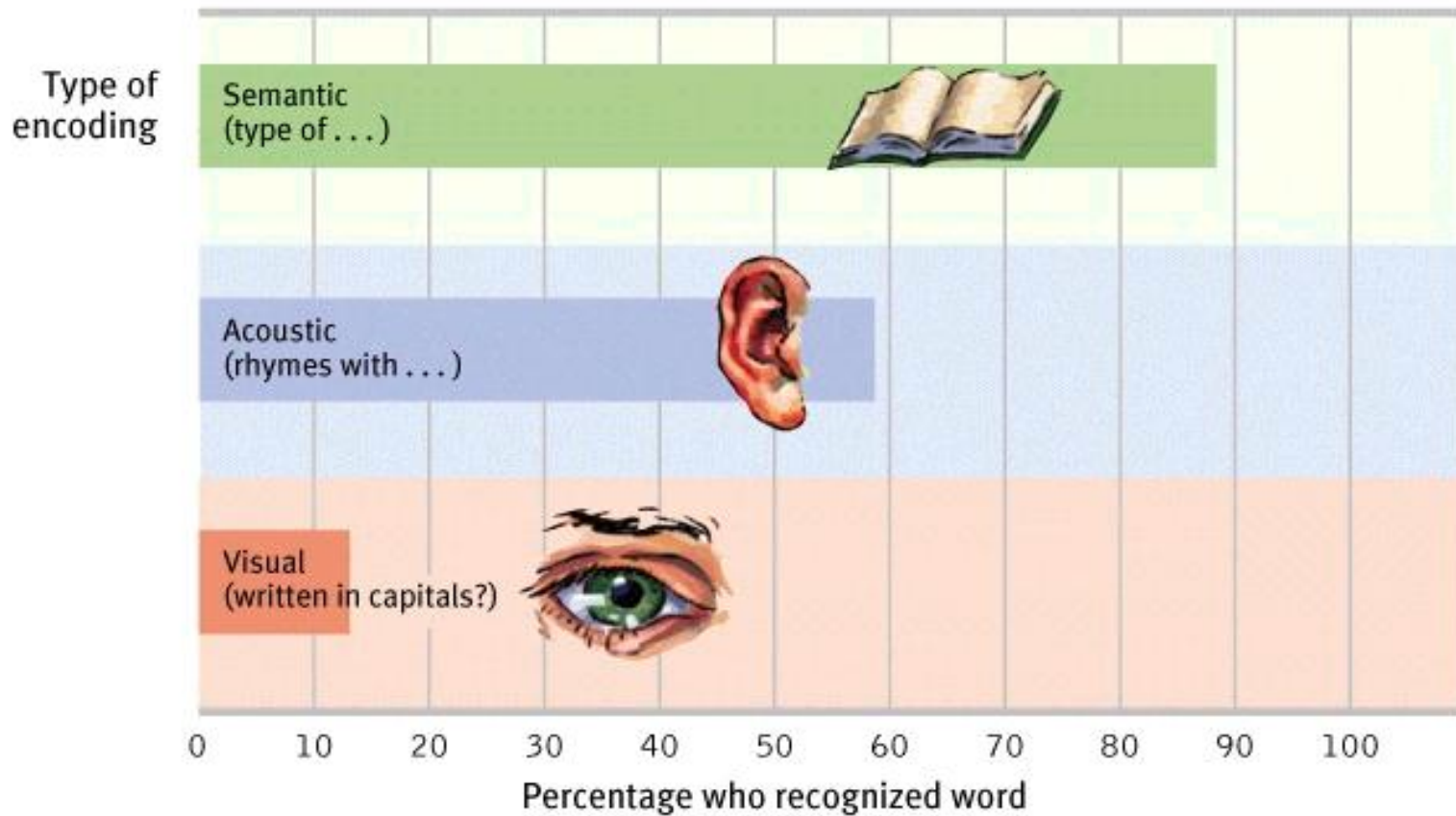
Intermediate

Q: Would the word fit
in the sentence?
He met a _____
in the street.

Semantic
Encoding

Deep

Results



Visual Encoding

Mental pictures (imagery) are a powerful aid to effortful processing, especially when combined with semantic encoding.



Both photos: Ho/AP Photo

Showing adverse effects of tanning and smoking in a picture may be more powerful than simply talking about it. 26

Mnemonics

Imagery is at the heart of many memory aids.
Mnemonic techniques use vivid imagery in
aiding memory.

1. Method of Loci
2. Link Method

Method of Loci

List of Items

Charcoal
Pens
Bed Sheets
Hammer
.
.
.
Rug

Imagined Locations

Backyard
Study
Bedroom
Garage
.
.
.
Living Room

Link Method

List of Items

Newspaper

Shaving cream

Pen

Umbrella

.

.

.

Lamp



Involves forming a mental image of items to be remembered in a way that links them together.

Organizing Information for Encoding

Break down complex information into broad concepts and further subdivide them into categories and subcategories.

1. Chunking
2. Hierarchy

Chunking

Organizing items into a familiar, manageable unit. Try to remember the numbers below.

1-7-7-6-1-4-9-2-1-8-1-2-1-9-4-1

If you are well versed with American history, chunk the numbers together and see if you can recall them better. 1776 1492 1812 1941.

Chunking

Acronyms are another way of chunking information to remember it.

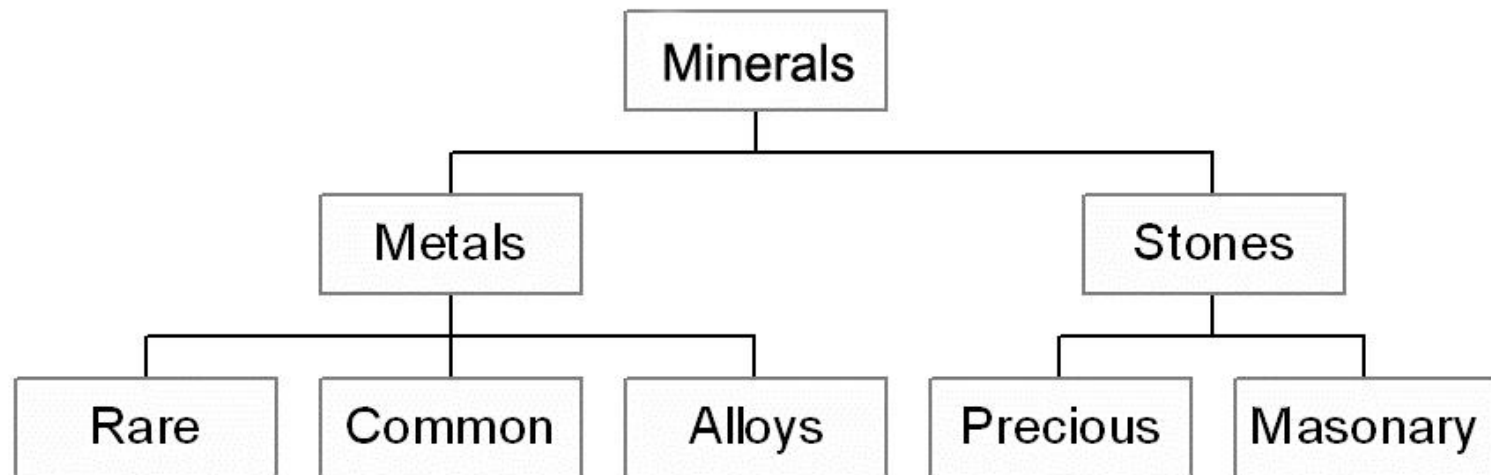
HOMES = Huron, Ontario, Michigan, Erie, Superior

PEMDAS = Parentheses, Exponent, Multiply, Divide, Add, Subtract

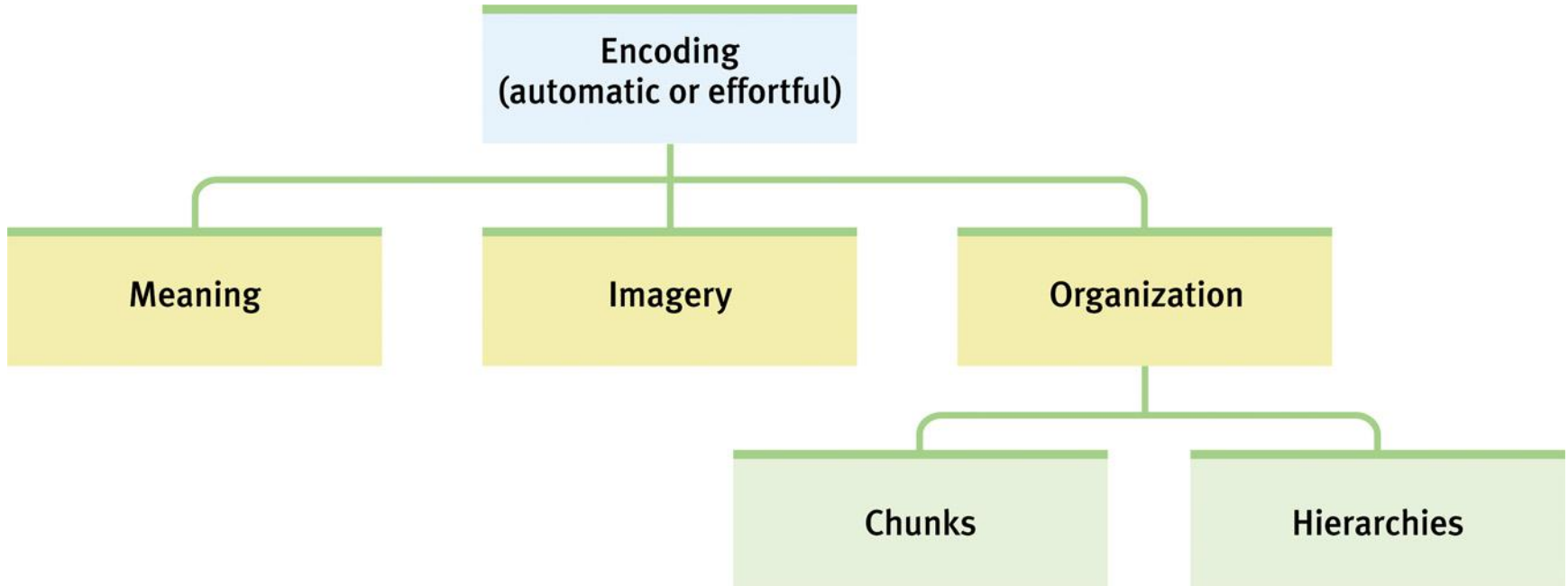
ROY G. BIV = Red, Orange, Yellow, Green, Blue, Indigo, Violet

Hierarchy

Complex information broken down into broad concepts and further subdivided into categories and subcategories.

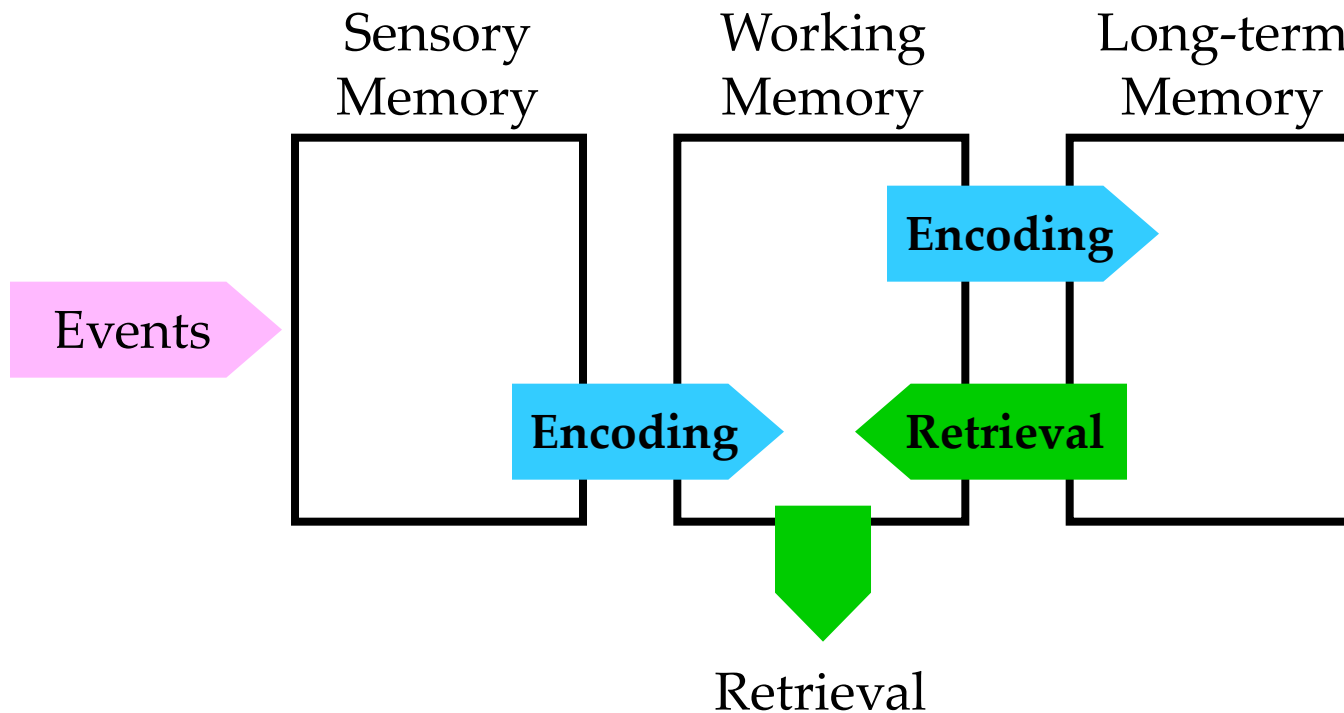


Encoding Summarized in a Hierarchy

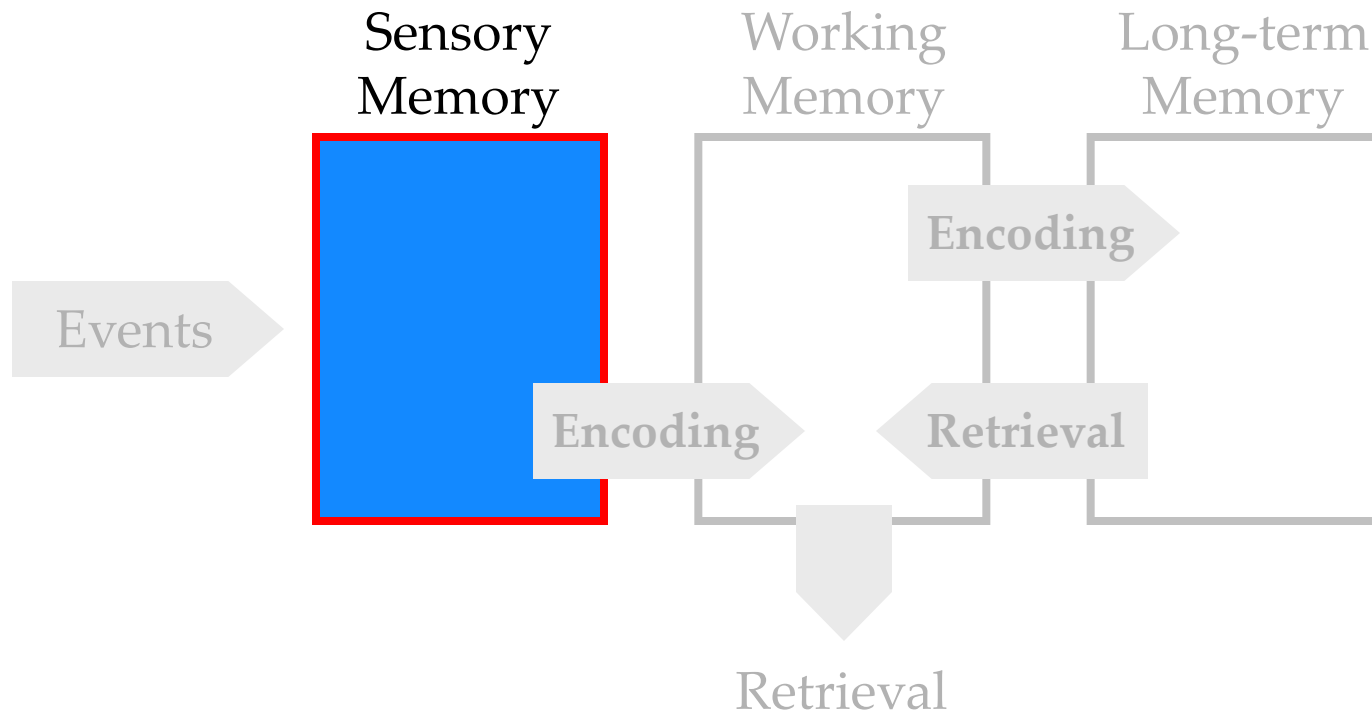


Storage: Retaining Information

Storage is at the heart of memory. Three stores of memory are shown below:

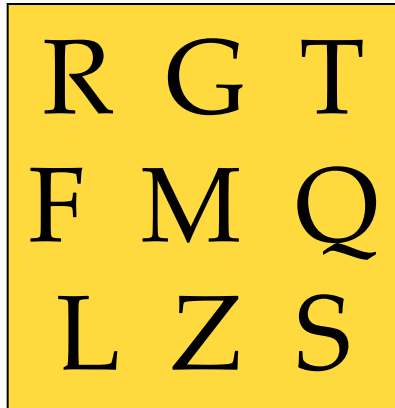


Sensory Memory



Whole Report

Sperling (1960)

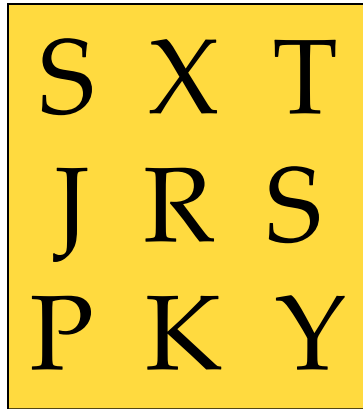


“Recall”
R T M Z
(44% recall)

50 ms (1/20 second)

The exposure time for the stimulus is so small
that items cannot be rehearsed.

Partial Report



A 3x3 grid of letters displayed on a yellow background. The letters are arranged as follows:
Row 1: S X T
Row 2: J R S
Row 3: P K Y

50 ms (1/20 second)

Low Tone

Medium Tone

High Tone

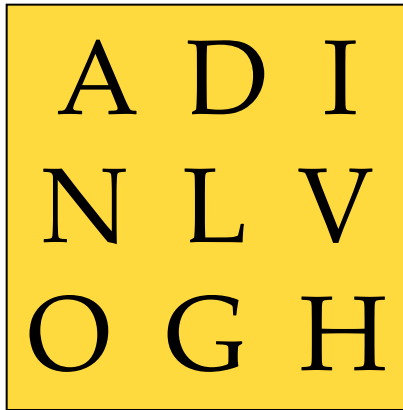
“Recall”

J R S

(100% recall)

Sperling (1960) argued that sensory memory capacity was larger than what was originally thought.

Time Delay



50 ms (1/20 second)

Time
Delay

Low Tone

Medium Tone

High Tone

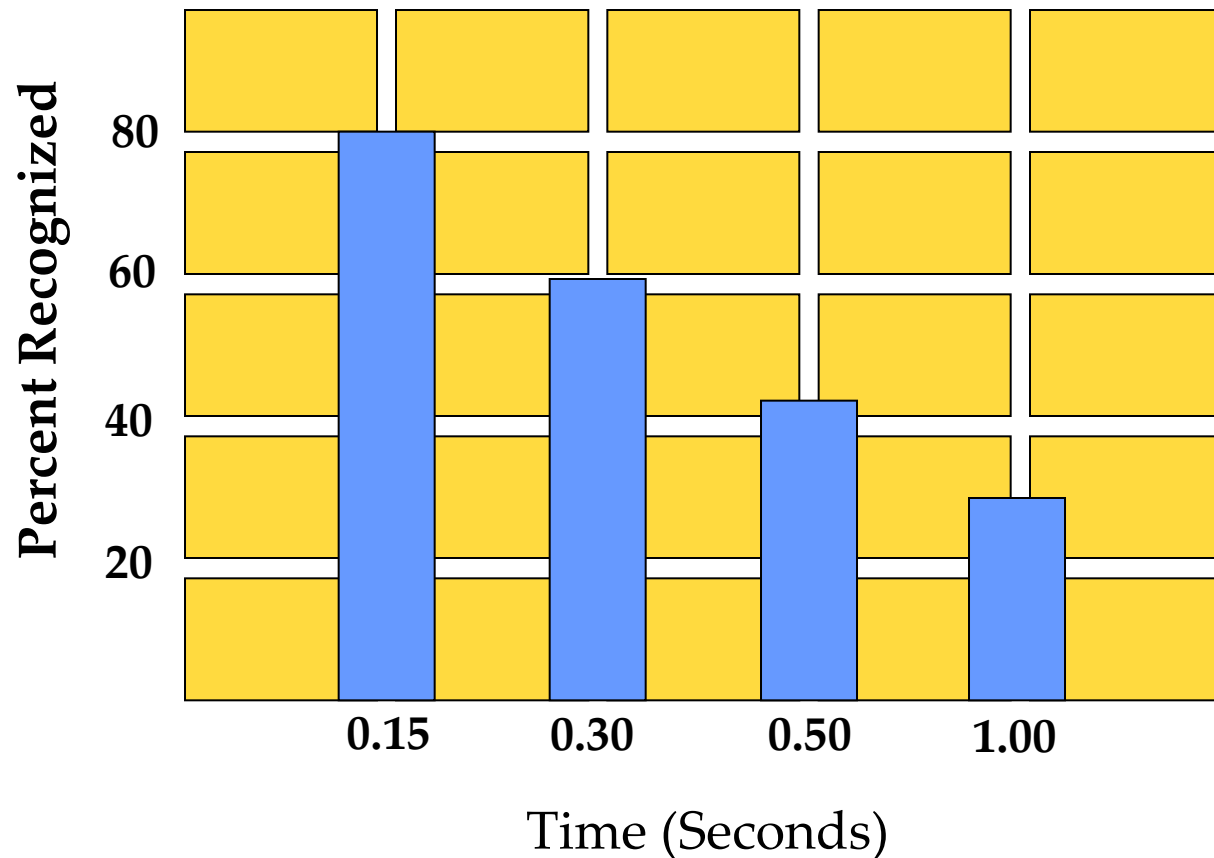
“Recall”

N _ _

(33% recall)

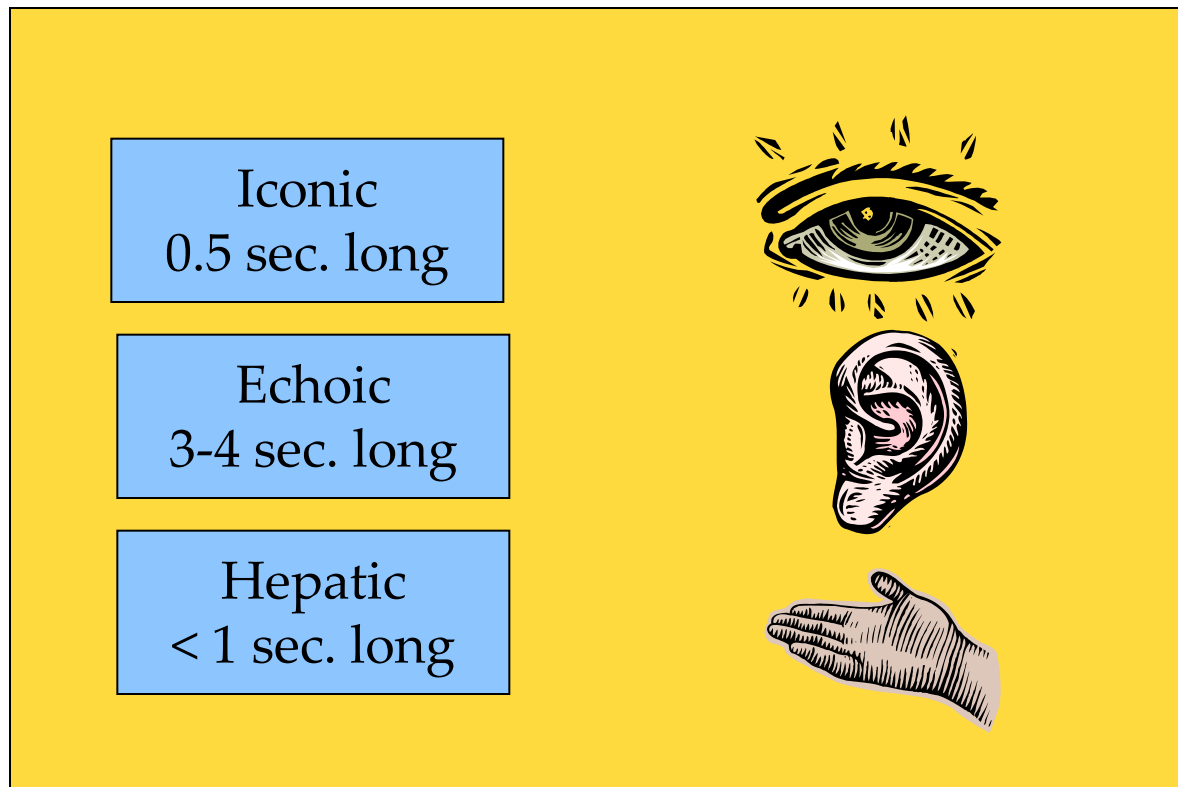
Sensory Memory

The longer the delay, the greater the memory loss.

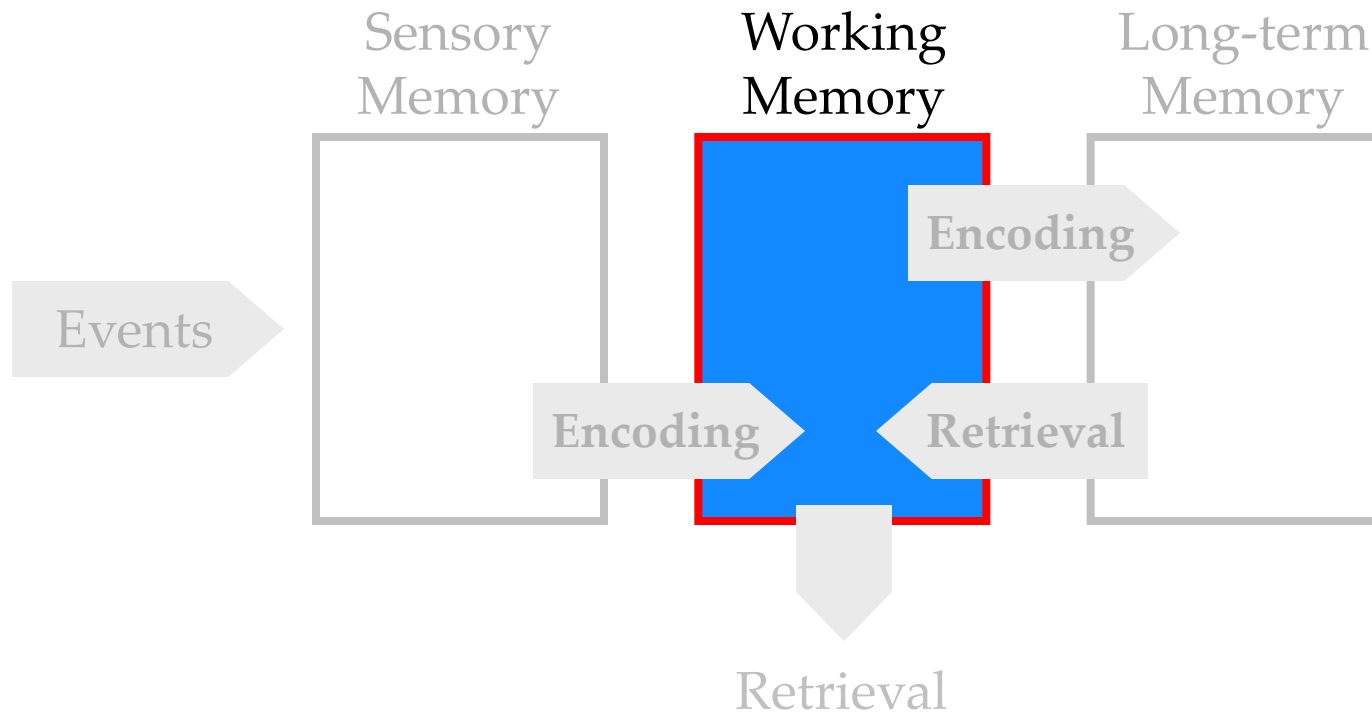


Sensory Memories

The duration of sensory memory varies for the different senses.



Working Memory



Working Memory

Working memory, the new name for short-term memory, has a limited capacity (7 ± 2) and a short duration (20 seconds).



Sir George Hamilton observed that he could accurately remember up to 7 beans thrown on the floor. If there were more beans, he guessed.

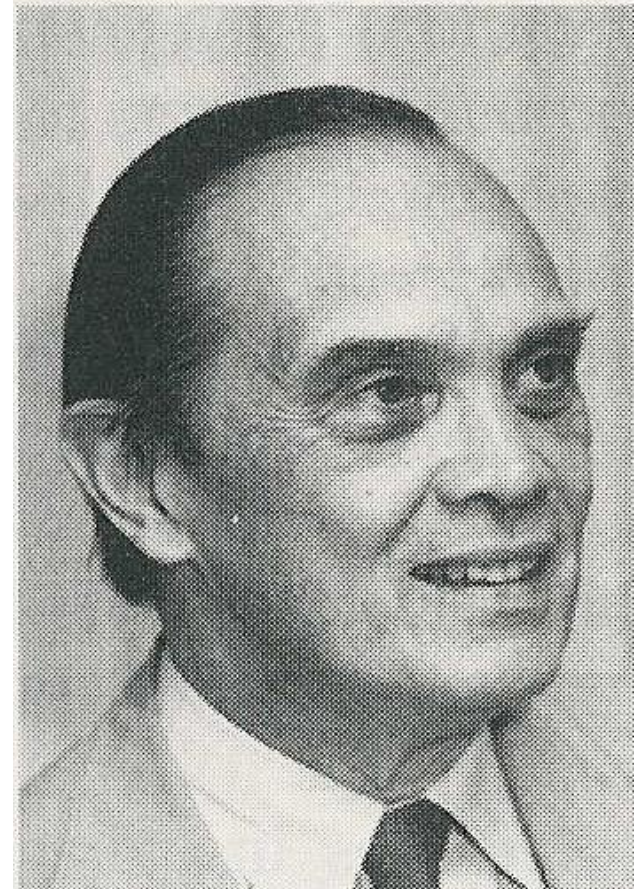
Capacity

The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information (1956).

Ready?

M U T G I K T L R S Y P

You should be able to
recall 7 ± 2 letters.



George Miller

Chunking

The capacity of the working memory may be increased by “Chunking.”

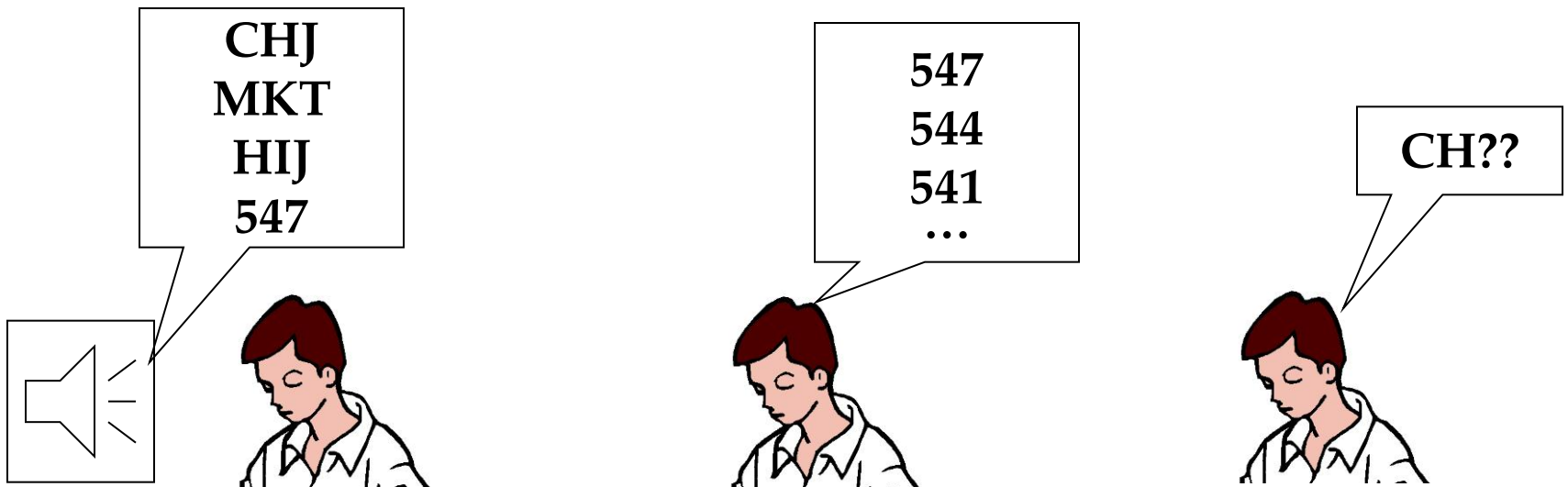
F-B-I-T-W-A-C-I-A-I-B-M

FBI TWA CIA IBM

4 chunks

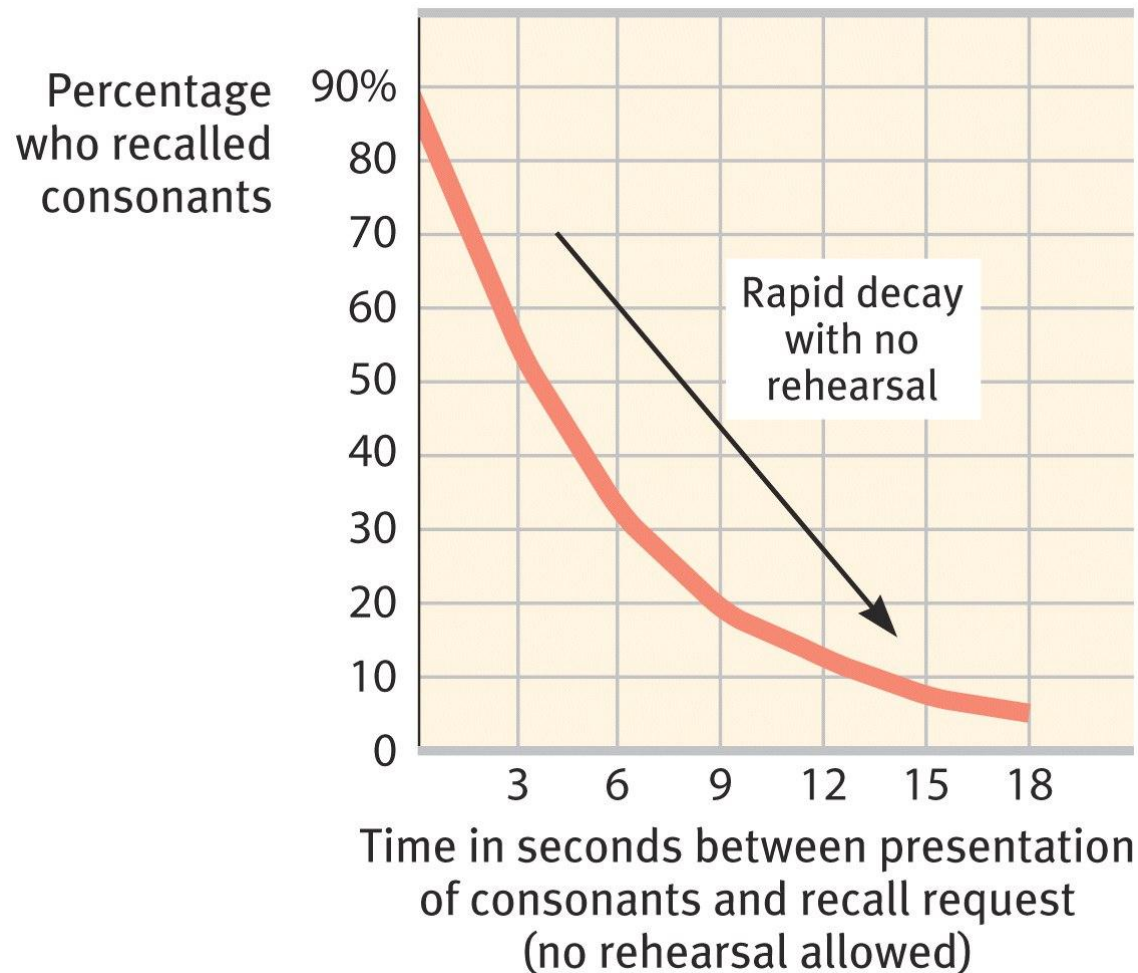
Duration

Brown/Peterson and Peterson (1958/1959) measured the duration of working memory by manipulating rehearsal.

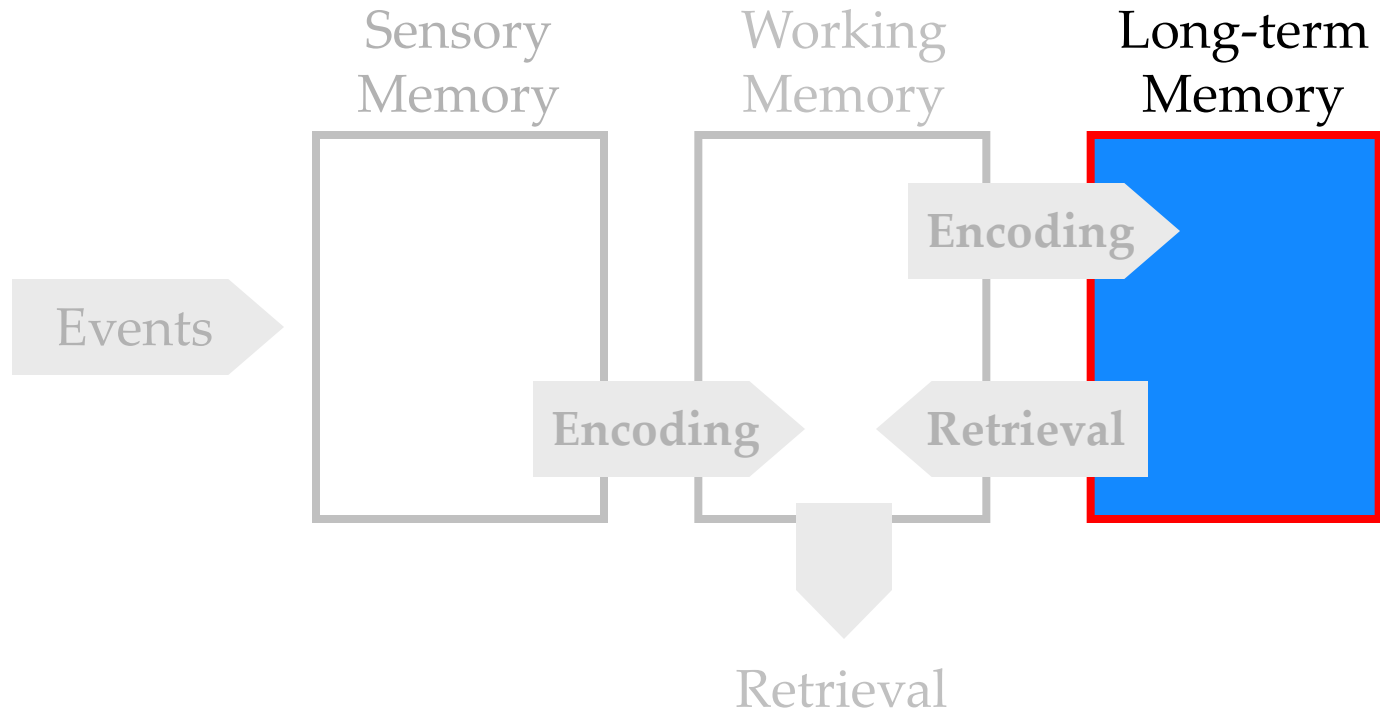


The duration of the working memory is about 20 sec.

Working Memory Duration



Long-Term Memory



Long-Term Memory

Unlimited capacity store. Estimates on capacity range from 1000 billion to 1,000,000 billion bits of information (Landauer, 1986).



R.J. Erwin/ Photo Researchers

The Clark's nutcracker can locate 6,000 caches of buried pine seeds during winter and spring.

Memory Feats

WORLD MEMORY CHAMPIONSHIP RECORDS

From world memory competition, here are some current records, as of 2005:

Contest	Description	Record
Speed cards	Shortest time to memorize a shuffled pack of 52 playing cards	33 seconds
One-hour cards	Most cards memorized in one hour (52 points for every pack correct; 26 points if 1 mistake)	1170 cards
Speed numbers	Most random digits memorized in 5 minutes	324 digits
Names and faces	Most first and last names memorized in 15 minutes after being shown with faces (1 point for every correctly spelled first or last name; 1/2 point for every phonetically correct but incorrectly spelled name)	167.5 names
Binary digits	Most binary digits (101101, etc.) memorized in 30 minutes when presented in rows of 30 digits	3705

Sources: usamemoriad.com and worldmemorychampionship.com

Memory Stores

Feature	Sensory Memory	Working Memory	LTM
Encoding	Copy	Phonemic	Semantic
Capacity	Unlimited	7±2 Chunks	Very Large
Duration	0.25 sec.	20 sec.	Years

Storing Memories in the Brain

1. Through electrical stimulation of the brain, Wilder Penfield (1967) concluded that old memories were etched into the brain.
2. Loftus and Loftus (1980) reviewed Penfield's data and showed that only a handful of brain stimulated patients reported flashbacks.
3. Using rats, Lashley (1950) suggested that even after removing parts of the brain, the animals retain partial memory of the maze.

Synaptic Changes

In *Aplysia*, Kandel and Schwartz (1982) showed that serotonin release from neurons increased after conditioning.

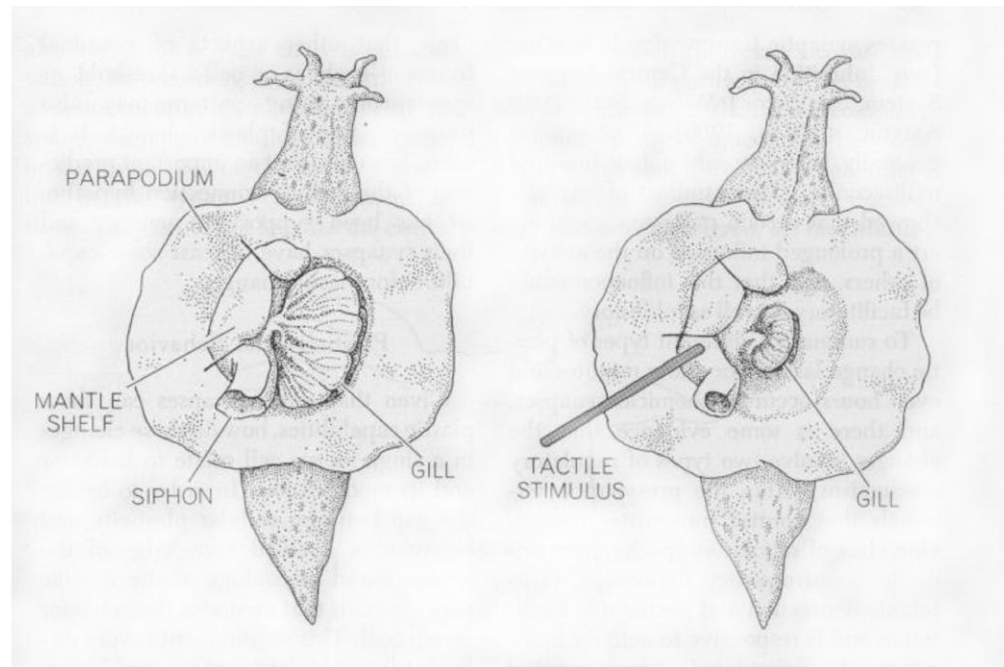
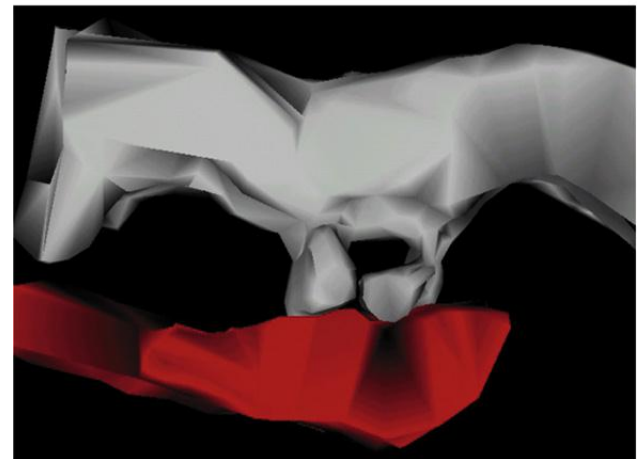
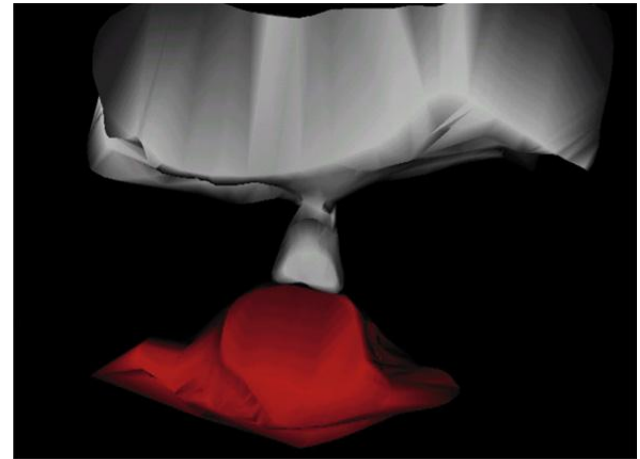


Photo: Scientific American

Synaptic Changes

Long-Term Potentiation (LTP) refers to synaptic enhancement after learning (Lynch, 2002).

An increase in neurotransmitter release or receptors on the receiving neuron indicates strengthening of synapses.



Both Photos: From N. Toni et al., Nature, 402, Nov. 25 1999, Courtesy of Dominique Muller

Stress Hormones & Memory

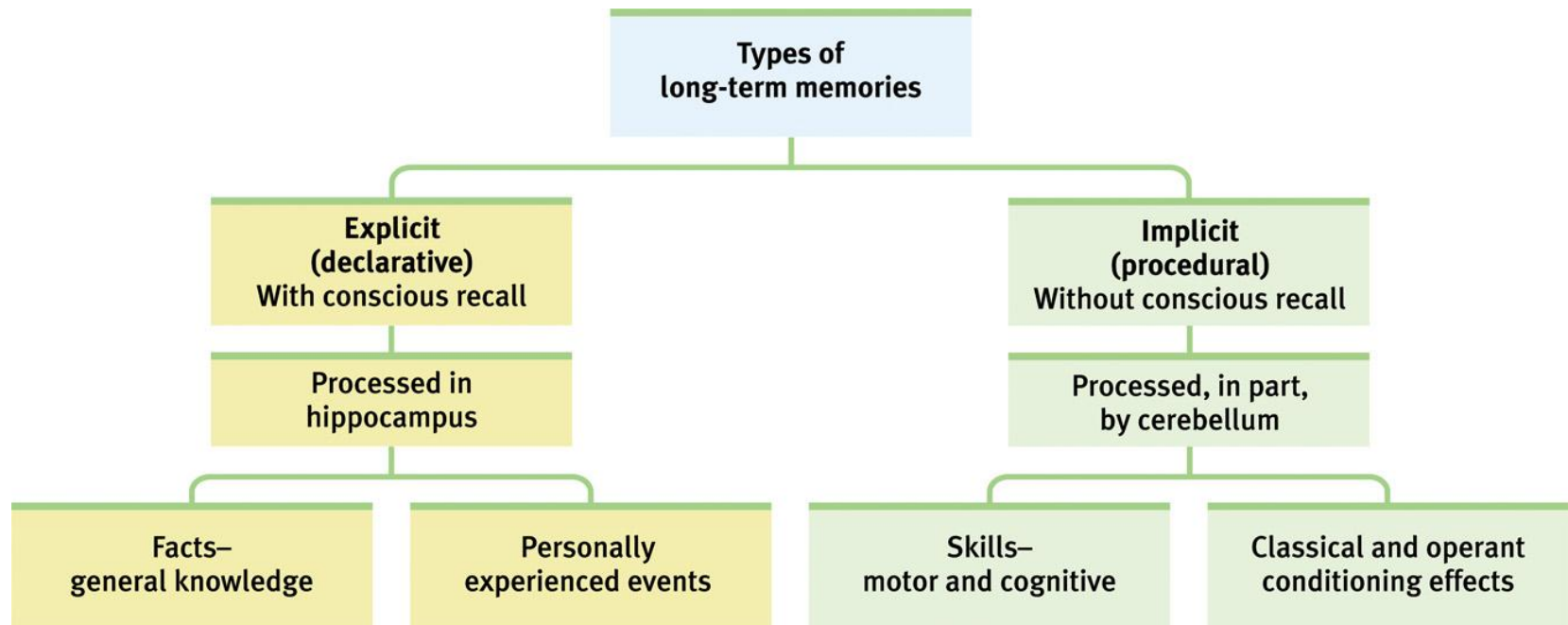
Heightened emotions (stress-related or otherwise) make for stronger memories. Continued stress may disrupt memory.



Scott Barbour/ Getty Images

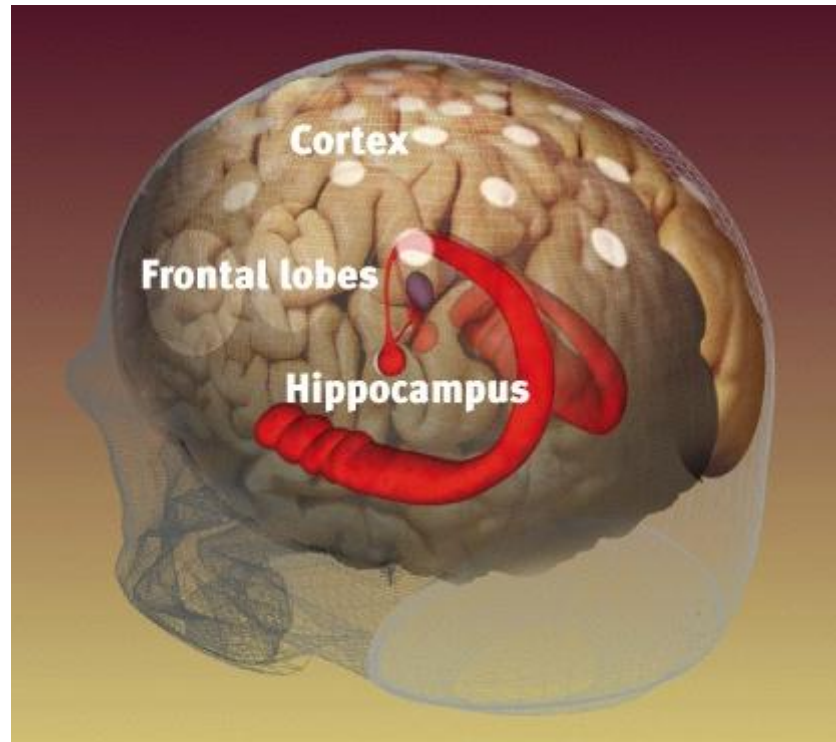
Storing Implicit & Explicit Memories

Explicit Memory refers to facts and experiences that one can consciously know and declare. **Implicit memory** involves learning an action while the individual does not know or declare what she knows.



Hippocampus

Hippocampus – a neural center in the limbic system that processes explicit memories.

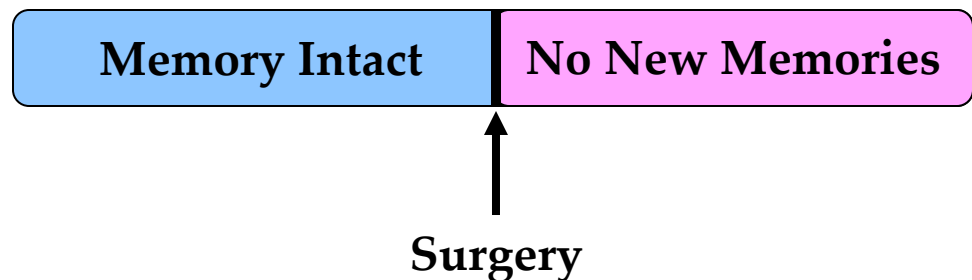


Weidenfield & Nicolson archives

Anterograde Amnesia

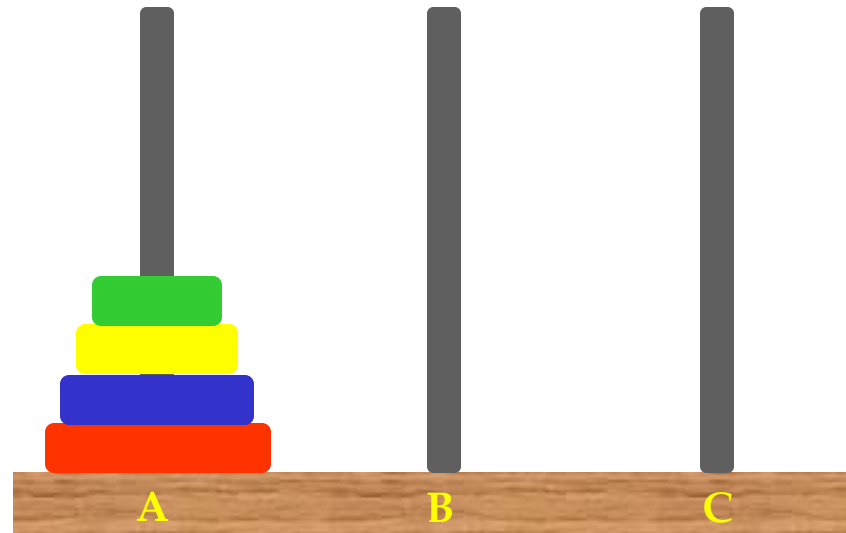
After losing his hippocampus in surgery, patient Henry M. (HM) remembered everything before the operation but cannot make new memories. We call this **anterograde amnesia**.

Anterograde
Amnesia
(HM)



Implicit Memory

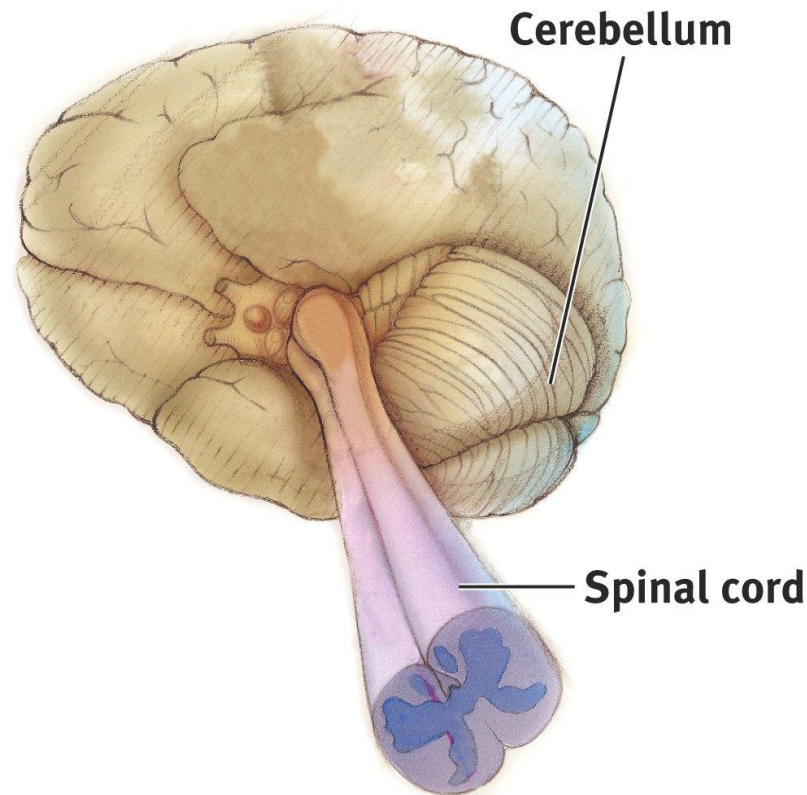
HM is unable to make new memories that are declarative (explicit), but he can form new memories that are procedural (implicit).



HM learned the Tower of Hanoi (game) after his surgery. Each time he plays it, he is unable to remember the fact that he has already played the game.

Cerebellum

Cerebellum – a neural center in the hindbrain that processes implicit memories.

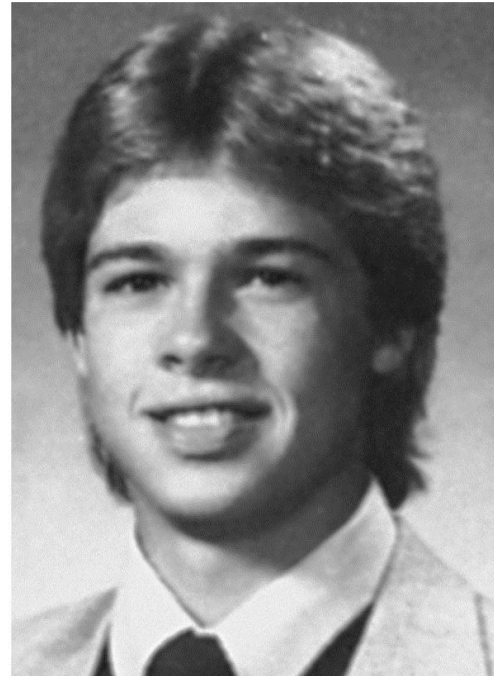


Retrieval: Getting Information Out

Retrieval refers to getting information out of the memory store.



Spanky's Yearbook Archive



Spanky's Yearbook Archive

Measures of Memory

In **recognition**, the person must identify an item amongst other choices. (A multiple-choice test requires recognition.)

1. Name the capital of France.
 - a. Brussels
 - b. Rome
 - c. London
 - d. Paris

Measures of Memory

In **recall**, the person must retrieve information using effort. (A fill-in-the blank test requires recall.)

1. The capital of France is _____.

Measures of Memory

In **relearning**, the individual shows how much time (or effort) is saved when learning material for the second time.

List

Jet
Dagger
Tree
Kite
...
Silk
Frog
Ring



List

Jet
Dagger
Tree
Kite
...
Silk
Frog
Ring

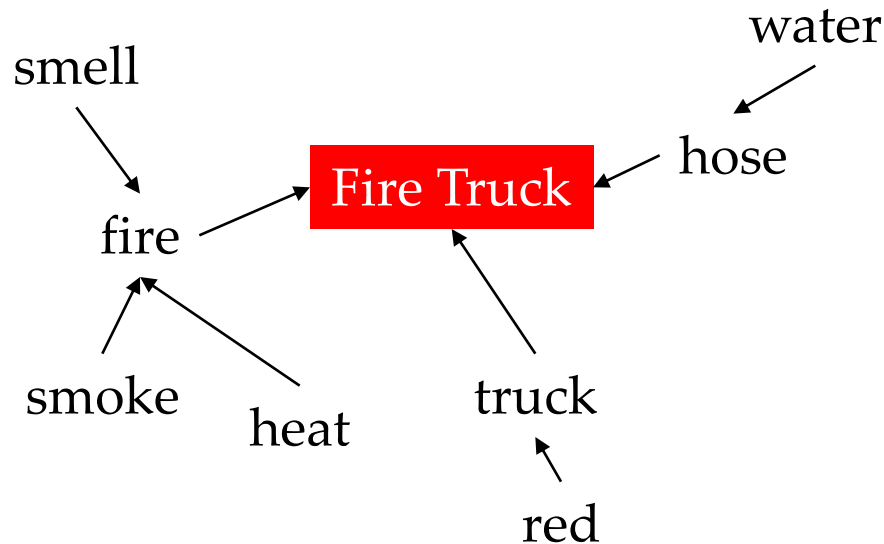
It took 10 trials
to learn this list

It took 5 trials
to learn the list

$$\begin{aligned}\text{Saving} &= \frac{\text{Original Trials} - \text{Relearning Trials}}{\text{Relearning Trials}} \times 100 \\ &= \frac{10 - 5}{10} \times 100 \\ &= 50\%\end{aligned}$$

Retrieval Cues

Memories are held in storage by a web of associations. These associations are like anchors that help retrieve memory.



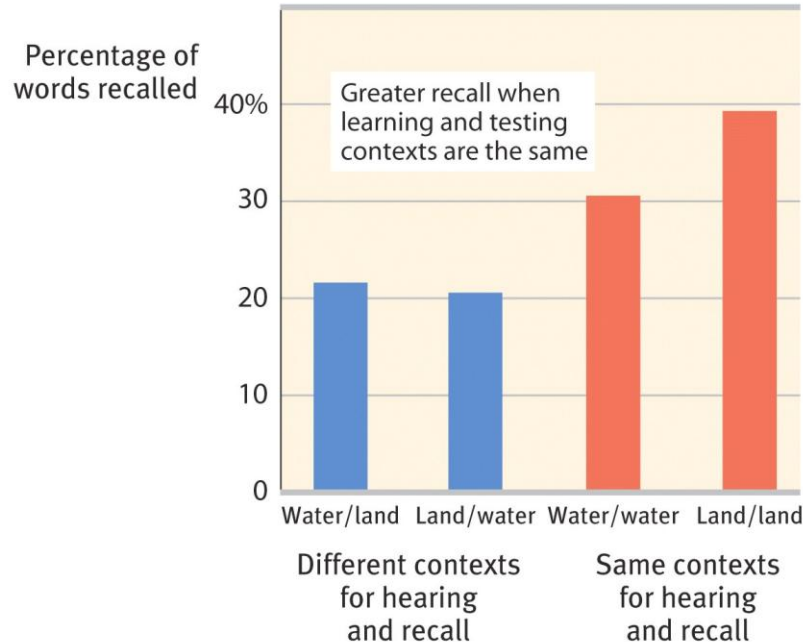
Priming

To retrieve a specific memory from the web of associations, you must first activate one of the strands that leads to it. This process is called **priming**.



Context Effects

Scuba divers recall more words underwater if they learned the list underwater, while they recall more words on land if they learned that list on land (Godden & Baddeley, 1975).



Déjà Vu

Déjà Vu means “I've experienced this before.”

Cues from the current situation may unconsciously trigger retrieval of an earlier similar experience.



Context Effects

After learning to move a mobile by kicking, infants most strongly respond when retested in the same context rather than in a different context (Butler & Rovee-Collier, 1989).



Courtesy of Carolyn Rovee-Collier,
Rutgers University

Moods and Memories

We usually recall experiences that are consistent with our current mood. Emotions, or moods, serve as retrieval cues.



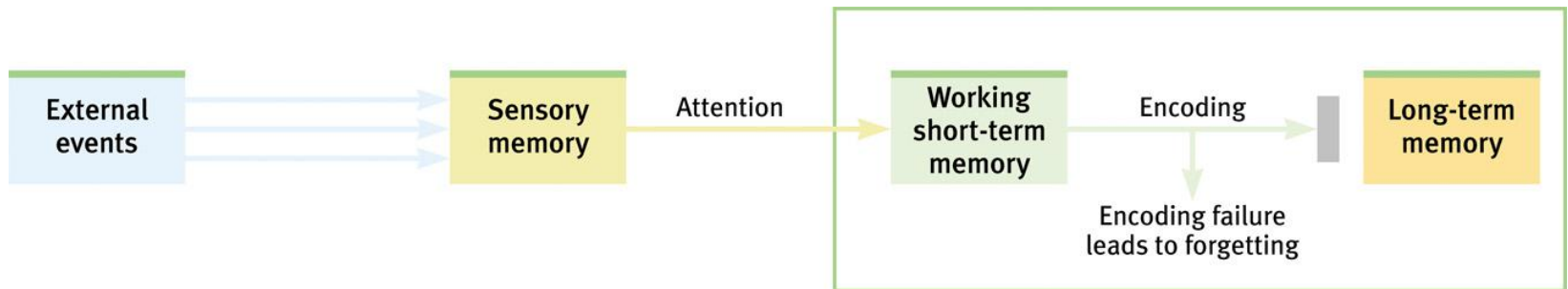
Jorgen Schytte/ Still Pictures

Forgetting

An inability to retrieve information due to poor encoding, storage, or retrieval.

Encoding Failure

We cannot remember what we do not encode.



Which penny is real?



(a)



(b)



(c)



(d)



(e)



(f)



(g)



(h)



(i)



(j)



(k)



(l)



(m)



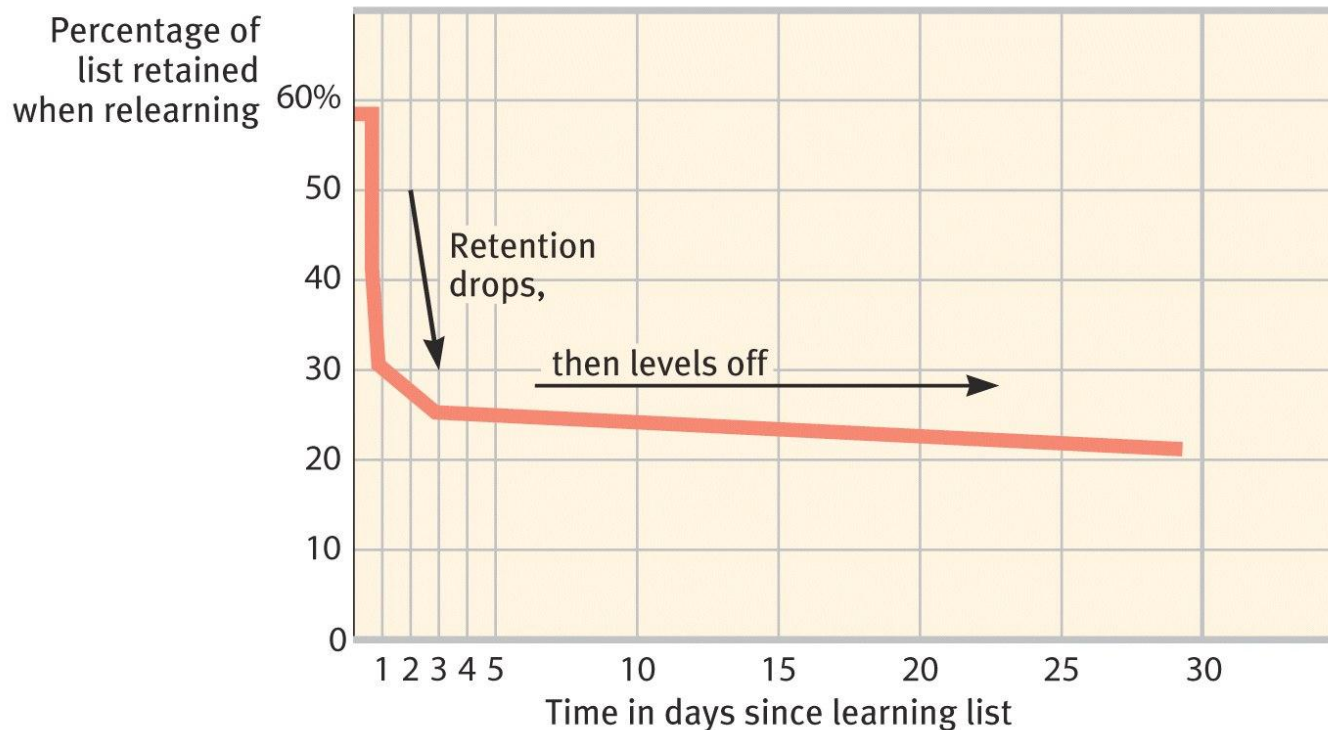
(n)



(o)

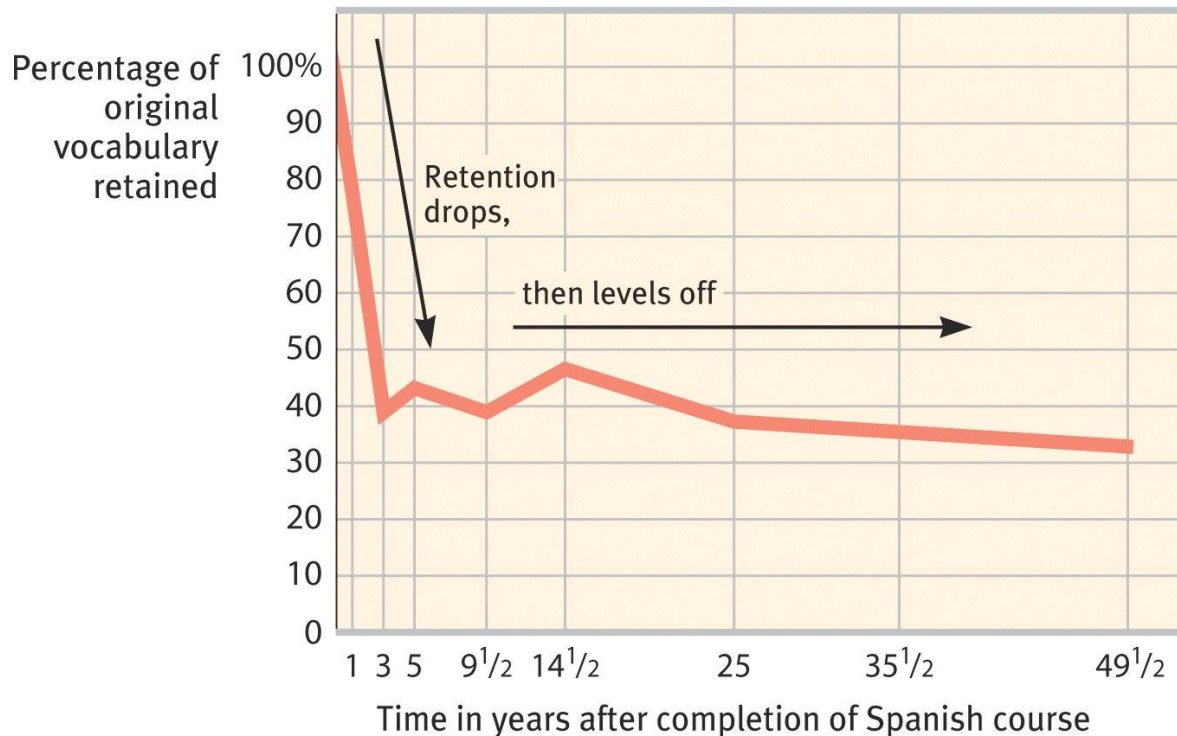
Storage Decay

Poor durability of stored memories leads to their decay. Ebbinghaus showed this with his forgetting curve.



Retaining Spanish

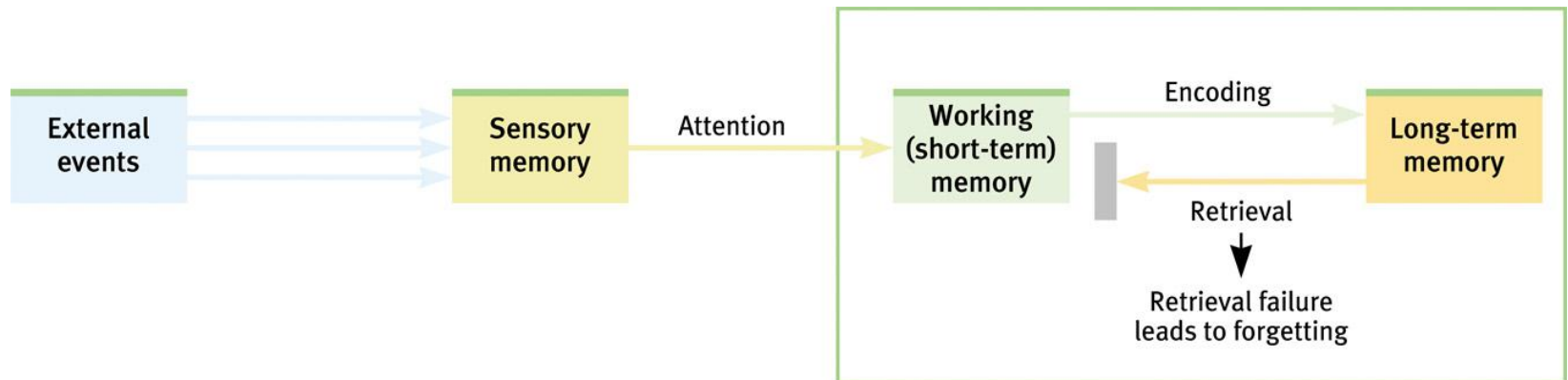
Bahrck (1984) showed a similar pattern of forgetting and retaining over 50 years.



Andrew Holbrooke/Corbis

Retrieval Failure

Although the information is retained in the memory store, it cannot be accessed.

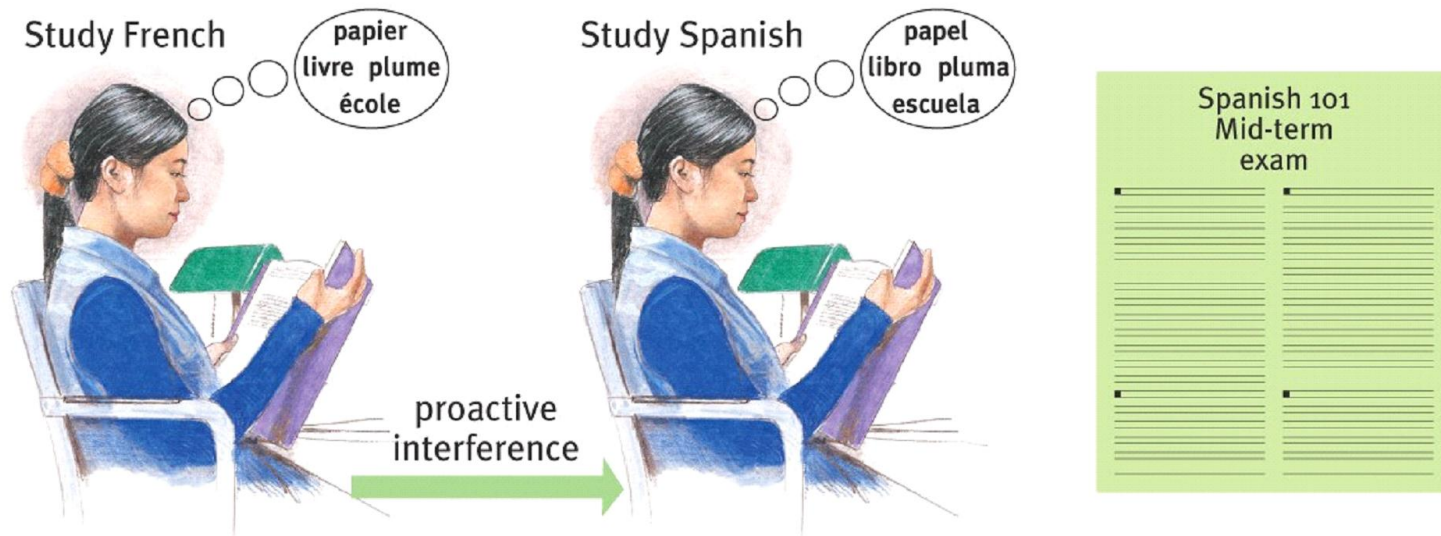


Tip-of-the-tongue (TOT) is a retrieval failure phenomenon. Given a cue (What makes blood cells red?) the subject says the word begins with an *H* (hemoglobin).

Interference

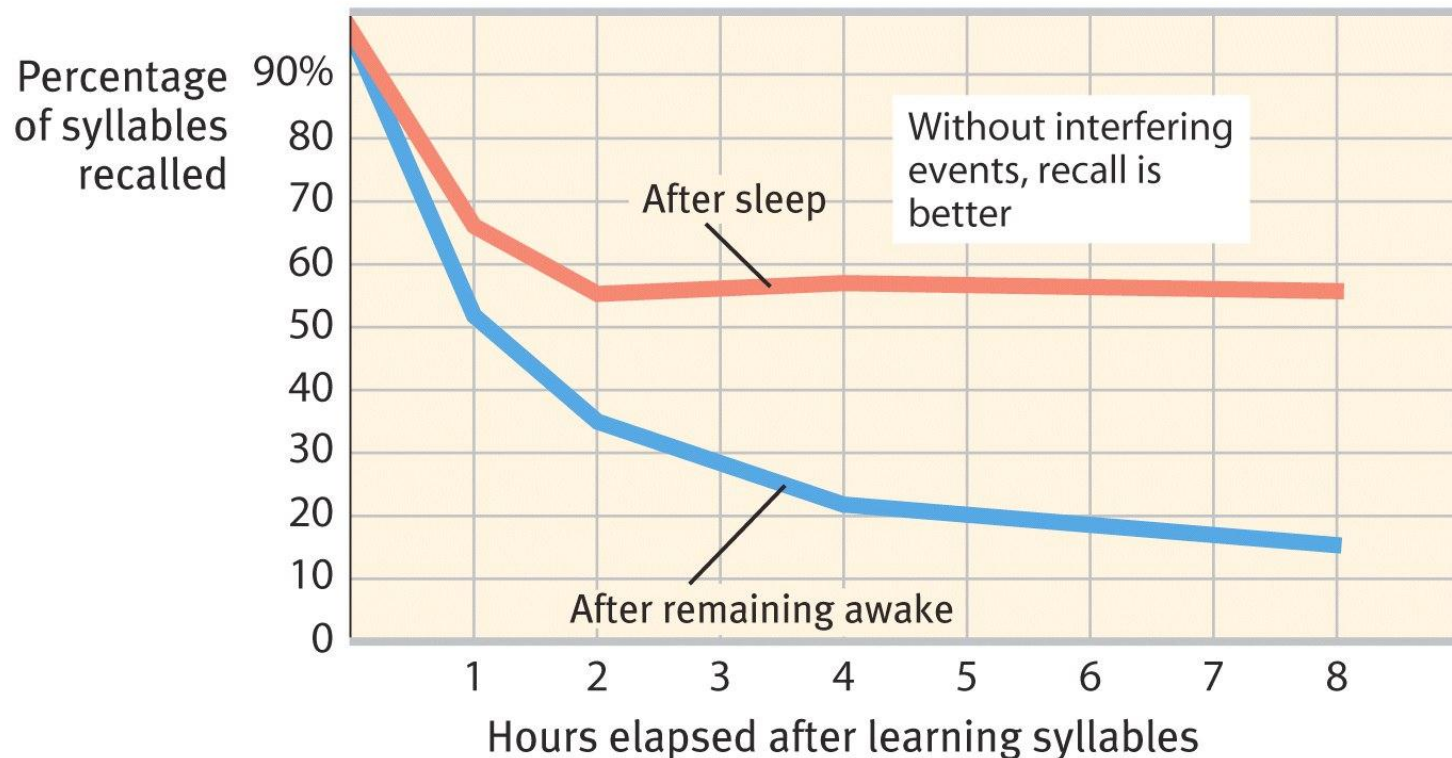
Learning some new information may disrupt retrieval of other information.

French learned beforehand, interferes proactively with a Spanish exam



Retroactive Interference

Sleep prevents retroactive interference. Therefore, it leads to better recall.

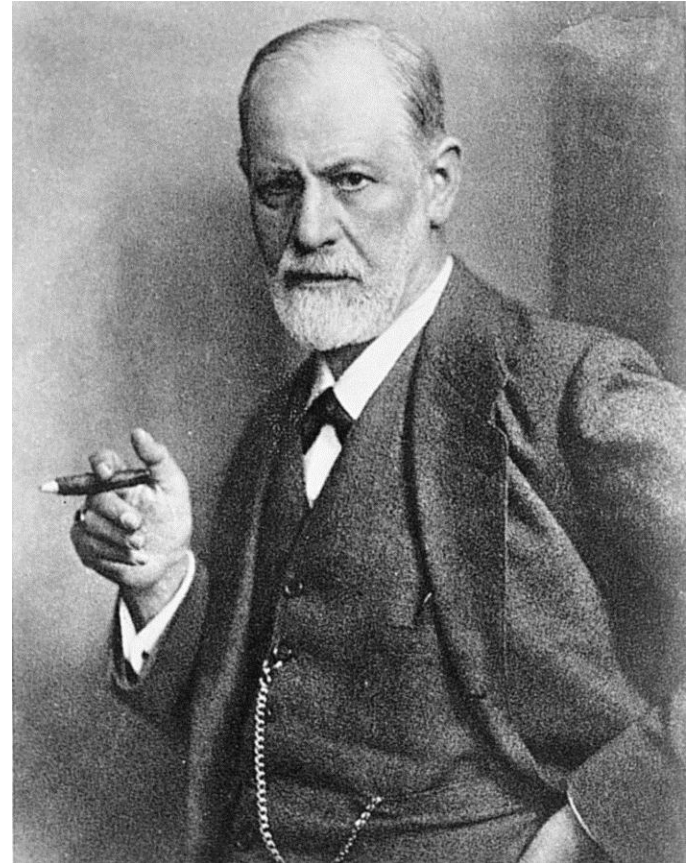


Motivated Forgetting

Motivated Forgetting:

People unknowingly revise their memories.

Repression: A defense mechanism that banishes anxiety-arousing thoughts, feelings, and memories from consciousness.

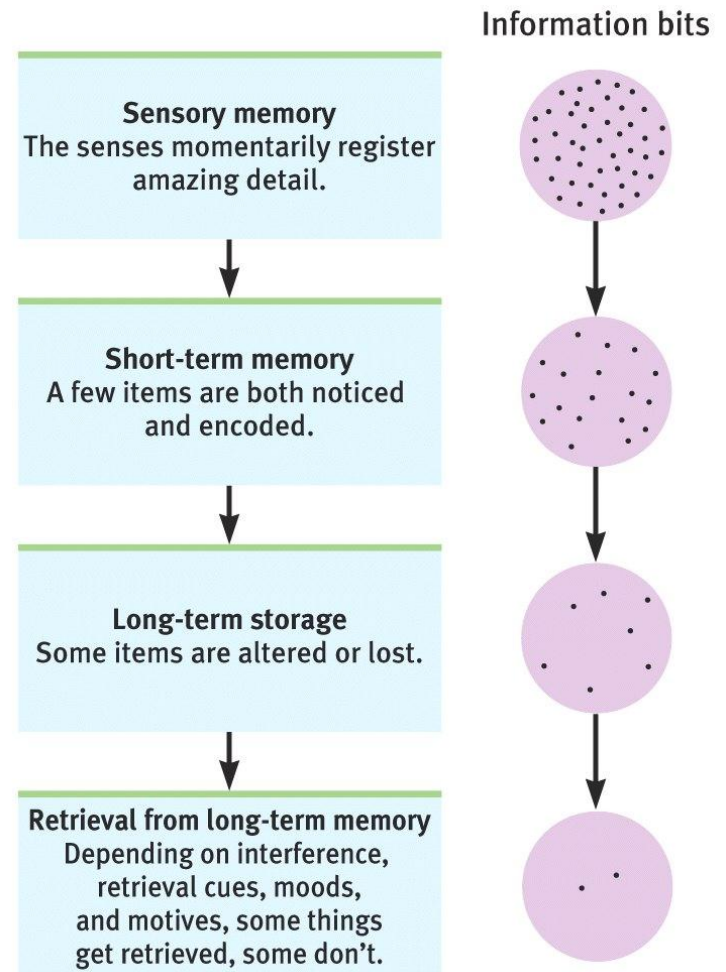


Culver Pictures

Sigmund Freud

Why do we forget?

Forgetting can occur at any memory stage. We filter, alter, or lose much information during these stages.



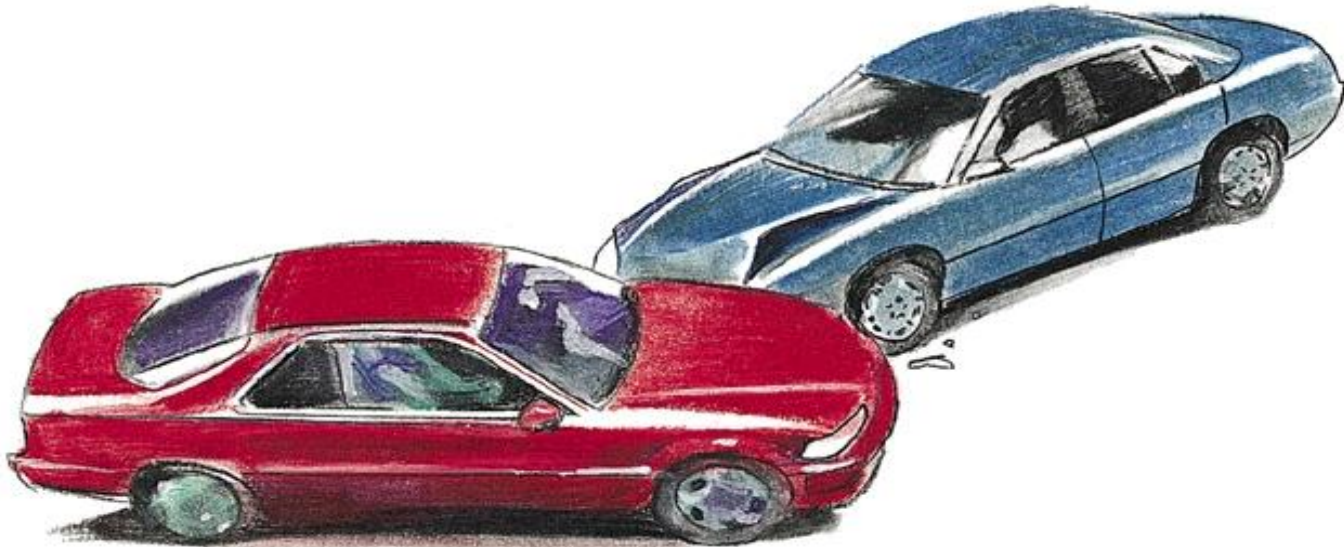
Memory Construction

While tapping our memories, we filter or fill in missing pieces of information to make our recall more coherent.

Misinformation Effect: Incorporating misleading information into one's memory of an event.

Misinformation and Imagination Effects

Eyewitnesses reconstruct their memories when questioned about the event.



Depiction of the actual accident.

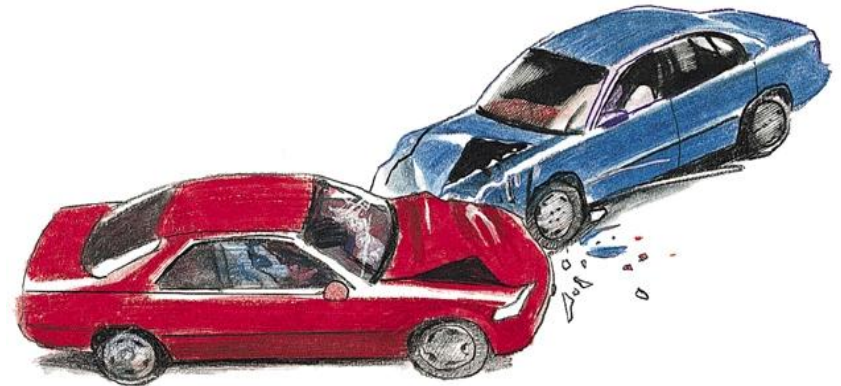
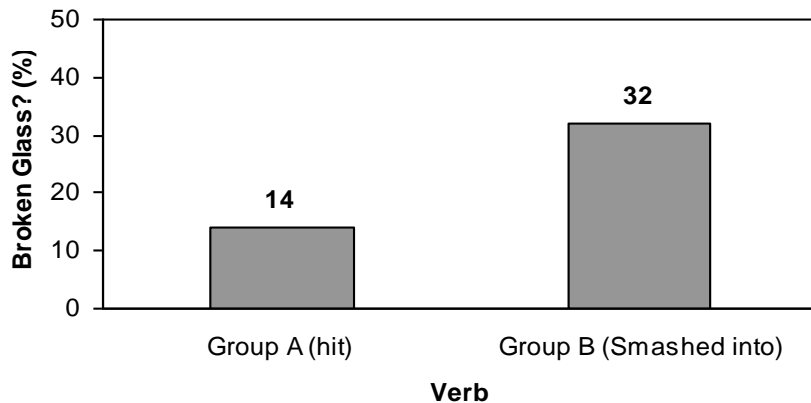
Misinformation

Group A: How fast were the cars going
when they *hit* each other?

Group B: How fast were the cars going
when they *smashed into* each
other?

Memory Construction

A week later they were asked: Was there any broken glass? **Group B (*smashed into*)** reported more broken glass than **Group A (*hit*)**.



Source Amnesia

Source Amnesia: Attributing an event to the wrong source that we experienced, heard, read, or imagined (misattribution).

Discerning True & False Memories

Just like true perception and illusion, real memories and memories that seem real are difficult to discern.



(a)



(b)

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When students formed a happy or angry memory of morphed (computer blended) faces, they made the (computer assisted) faces (a), either happier or (b) angrier. 86

False Memories

Repressed or Constructed?

Some adults actually do forget childhood episodes of abuse.

False Memory Syndrome

A condition in which a person's identity and relationships center around a false but strongly believed memory of a traumatic experience, which is sometimes induced by well-meaning therapists.

Children's Eyewitness Recall

Children's eyewitness recall can be unreliable if leading questions are posed. However, if cognitive interviews are neutrally worded, the accuracy of their recall increases. In cases of sexual abuse, this usually suggests a lower percentage of abuse.

Memories of Abuse

Are memories of abuse repressed or constructed?

Many psychotherapists believe that early childhood sexual abuse results in repressed memories.

However, other psychologists question such beliefs and think that such memories may be constructed.

Constructed Memories

Loftus' research shows that if false memories (lost at the mall or drowned in a lake) are implanted in individuals, they construct (fabricate) their memories.



Don Shrubshell

Consensus on Childhood Abuse

Leading psychological associations of the world agree on the following concerning childhood sexual abuse:

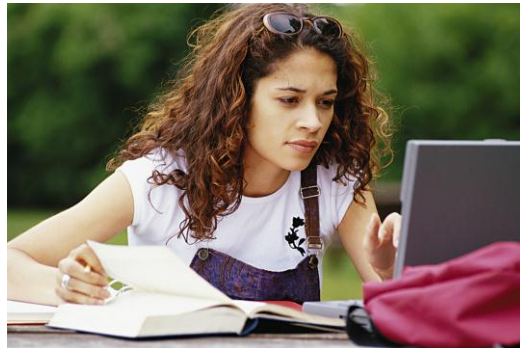
1. Injustice happens.
2. Incest and other sexual abuse happens.
3. People may forget.
4. Recovered memories are commonplace.
5. Recovered memories under hypnosis or drugs are unreliable.
6. Memories of things happening before 3 years of age are unreliable.
7. Memories, whether real or false, are emotionally upsetting.

Improving Memory

1. Study repeatedly to boost long-term recall.
2. Spend more time rehearsing or actively thinking about the material.
3. Make material personally meaningful.
4. Use mnemonic devices:
 - associate with peg words — something already stored
 - make up a story
 - chunk — acronyms

Improving Memory

5. Activate retrieval cues — mentally recreate the situation and mood.
6. Recall events while they are fresh — before you encounter misinformation.
7. Minimize interference:
 1. Test your own knowledge.
 2. Rehearse and then determine what you do not yet know.



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